

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

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PCT

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of Mailing
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10 FEB 2005

Applicant's or agent's file reference

60,469-065

IMPORTANT NOTIFICATION

International application No.

International filing date (day/month/year)

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PCT/US02/39945

13 December 2002 (13.12.2002)

13 December 2002 (13.12.2002)

Applicant

OTIS ELEVATOR COMPANY

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.
4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices)(Article 39(1))(see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/US

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 60,469-065	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US02/39945	International filing date (day/month/year) 13 December 2002 (13.12.2002)	Priority date (day/month/year) 13 December 2002 (13.12.2002)
International Patent Classification (IPC) or national classification and IPC IPC(7): B66B 21/00 and US Cl.: 198/330, 834		
Applicant OTIS ELEVATOR COMPANY		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

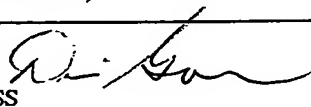
☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the

PCT).

These annexes consist of a total of 15 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of report with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 09 July 2004 (09.07.2004)	Date of completion of this report 13 January 2005 (13.01.2005)
Name and mailing address of the IPEA/US Mail Stop PCT, Attn: IPEA/ US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703) 305-3230	Authorized officer  DOUGLAS A. HESS Telephone No. 703-308-1113

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US02/39945

I. Basis of the report**1. With regard to the elements of the international application:***

- ☐ the international application as originally filed.
- ☒ the description:
pages 1-3 and 11 as originally filed
pages 4-10, filed with the demand
pages NONE, filed with the letter of _____.
- ☒ the claims:
pages 15-18, as originally filed
pages NONE, as amended (together with any statement) under Article 19
pages 12-14, filed with the demand
pages NONE, filed with the letter of _____.
- ☒ the drawings:
pages 1, 3-6, as originally filed
pages 2, 7-10, filed with the demand
pages NONE, filed with the letter of _____.
- ☐ the sequence listing part of the description:
pages NONE, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in printed form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages NONE
- ☐ the claims, Nos. NONE
- ☐ the drawings, sheets/fig NONE

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US02/39945**V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. STATEMENT**

Novelty (N)	Claims <u>1-17</u>	YES
	Claims <u>NONE</u>	NO
Inventive Step (IS)	Claims <u>1-17</u>	YES
	Claims <u>NONE</u>	NO
Industrial Applicability (IA)	Claims <u>1-17</u>	YES
	Claims <u>NONE</u>	NO

2. CITATIONS AND EXPLANATIONS

Claims 1-17 meet the criteria set out in PCT Article (2)-(3), because the prior art does not teach or fairly suggest a drive assembly including a stepchain link having a plurality of teeth of an integrated piece of material than span an entire width of an interface of the stepchain link and the drive member.

Figure 12B schematically illustrates an end view of the example attachment member of Figure 12A taken along line 12B-12B;

Figure 13 schematically illustrates another example outer portion of a link including injection molded teeth; and

5 Figure 14 schematically illustrates a rear view of the bridge supported by the stepchain links of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 schematically illustrates a passenger conveyor system 20. This example shows an escalator, but this invention is not so limited. Other conveyors are within the scope of this invention, such as moving walkways. This passenger conveyor system 20 includes steps 24 configured to travel in a loop and having a tread surface 26 and a rise surface 28. A drive assembly 29 moves the plurality of steps 24 in a desired direction. The opposing ends of each step 24 include a disc member 46. A bridge 49 is positioned between the disc members 46 of adjacent steps 24 to close the gap between the disc members 46.

As shown in Figure 2, the drive assembly 29 includes a plurality of stepchain links 30 which form a continuous loop. The stepchain links 30 have a plurality of teeth 32 that engage an outer surface 34 of a drive member 36. Preferably, the outer surface 34 of the drive member 36 has a profile that corresponds to the profile of the plurality of teeth 32. In one example, each tooth 32 has a height of 5 mm and a pitch of 20 mm.

The drive member 36 in one example preferably has a width X of 65 mm wide and the stepchain links 30 preferably have a width Y of 70 mm (shown in Figure 10). The drive member 36 in one example is a belt that is formed of polyurethane and includes a plurality of cords. In this example, the plurality of cords are made of steel or Kevlar and are the tensile carrying portion of the drive member 36. The drive member 36 is formed by placing the cords in a two piece mold. Polyurethane is introduced into the mold, integrating the plurality of cords within the polyurethane. In such an arrangement, as the drive member 36 is polyurethane, lubrication is not

needed between the stepchain links 30 and the drive member 36 as there is no metal-to-metal engagement. In another example, the drive member 36 is a drive chain.

5 A drive sheave 38 engages an inner surface 40 of the drive member 36 to move the drive member 36 around a loop. An idle sheave 42 is positioned at an opposite end of the loop from the drive sheave 38. A drive mechanism 44 is schematically shown for moving the drive sheave 38 in the desired direction and at the desired speed. The drive mechanism 44 includes a motor and a braking mechanism as known in the art, for example. Preferably, the passenger conveyor system 20 includes two drive members 36 running in parallel at the lateral edges of the steps 24 and two sets of continuous stepchain links 30. Each set of continuous stepchain links 30 cooperates with one of the drive members 36.

15 Teeth 32 on the stepchain links 30 engage the outer surface 34 of the drive member 36 so that the steps 24 move responsive to the drive mechanism 44. Various tooth 32 profiles may be used, depending on the particular arrangement. In the present invention, the teeth 32 are made of an integrated single piece of material.

As shown in Figure 3, each step 24 includes a disc member 46 adjacent each side edge of the step 24. The disc members 46 prevent objects from getting caught along the edges of the passenger conveyor system 20 during operation and moves with the steps 24.

20 As shown in Figure 4, the ends 58 and 60 of the axle 52 are attached to a corresponding stepchain link 30. The cap 186 is attached by the hub portion 50 of the disc members 46 such that the stepchain links 30 are positioned outwardly of the disc members 46.

25 Figure 5 illustrates a first example stepchain link 130 made of die cast metal, such as aluminum or magnesium. The stepchain link 130 includes a plurality of teeth 132, a first end 168 having a hole 170, and a second end 172 with two spaced portions 174 and 175 each having a hole 176 and 178, respectively. The axle 52 is press-fit into a hole 182 in the stepchain link 130.

30 Each stepchain link 130 further includes a bridge support 180 which supports the bridge 49 positioned between the disc members 46 of adjacent steps 24 during operation of the conveyor system 20 (further shown in Figure 1). The bridge 49, as

further shown in Figure 14, is preferably made of aluminum. The bridge 49 is substantially v-shaped and includes an enlarged upper end 55 and a smaller lower end 57. Sides 59 extend from the upper end 55 to the lower end 57. Each bridge 49 includes a pin 51 on the lower end 57 which is received in the bridge support 180, securing the bridge 49 to the stepchain link 130.

The link 130 further includes a webbed portion 173 which carries the tensile forces when the plurality of stepchain links 130 are in tension. The webbed portion 173 prevents bending and transfers tensile forces from the spaced portions 174 and 175 to the first end 168.

Figure 6 illustrates an example pair of stepchain links 130a and 130b. The first end 168b of the stepchain link 130b is inserted between the two spaced apart portions 174a and 175a of stepchain link 130a. As shown in Figure 7, the holes 170b, 176a and 178a are aligned and receive an attachment member 184, securing the stepchain links 130a and 130b together. A cap 186 and a stepchain roller 188 are attached to the opposing ends of the attachment member 184. The shouldered attachment member 184 secures the stepchain links 130a and 130b and is press fit in the hole 170b, fixing the distance between the wheel 64 and the cap 186.

As further shown in Figure 7, needle bearings 190 are positioned between the attachment member 184 and the holes 176a and 178a, eliminating the need for lubrication. The needle bearings 190 rotate around the attachment member 184. The lubrication is sealed in the bearings 190 during assembly, eliminating the need to lubricate the bearing 190 during use. Although only two stepchain links 130a and 130b are illustrated and described, it is to be understood that a plurality of stepchain links 130 are employed to create a continuous loop.

Although the stepchain links 130a and 130b have been described as having a first end 168 and a second end 172 with two spaced portions 174 and 175, it is to be understood that stepchain links 130a can include two first ends 168a and stepchain links 130b can include two second ends 172b having two spaced apart portions 174b and 175b. The stepchain links 130a and 130b are assembled in an alternating pattern to create a continuous loop.

In another example, the stepchain links 230 are made of sheet metal portions, as shown in Figures 8A to 10. In one example, steel is the preferred material. The steel can be stamped or laser cut. Figures 8A to 8D show two links 230a and 230b at various stages of assembly.

5 Each stepchain link 230a and 230b in this example includes two inner portions 262. The inner portions 262 of the stepchain link 230b are spaced close together. The inner portions 262 of the stepchain link 230a are spaced farther apart and are outside of the inner portions 262 of the stepchain link 230b. Each inner portion has a first hole 264 near one end a second hole 266 at an opposite end. The inner portions 262
10 include a plurality of inner teeth 268 and a plurality of attachment holes 270. Although Figure 8A illustrates four attachment holes 270 on each inner portion 262, it is to be understood that any number of attachment holes 270 can be employed.

The inner portions 262 are assembled in an alternating manner such that both the first holes 264 and the second holes 266 of a first stepchain link 230a are located
15 outwardly of the first holes 264 and second holes 266 of the adjacent stepchain links 230b. That is, the second holes 266 of the inner portions 262 of a first stepchain link 230a are positioned outwardly of the first holes 264 of the inner portions 262 of a second stepchain links 230b. The second holes 266 of the inner portions 262 of the second stepchain link 230b are positioned inwardly of the first holes 264 of a third
20 stepchain link (not shown). The second holes 266 of the inner portions 262 of the third stepchain link (not shown) are positioned outwardly of the first holes 264 of a fourth stepchain link (not shown), and so on.

As shown in Figure 8B, an attachment member 284 is inserted in the aligned
25 holes 264 of one link and 266 of an adjacent link to secure the inner portions of the links together. The holes 266 are larger than the holes 264, and needle bearings (not shown) are press fit in the holes 266, eliminating the need for lubrication. The attachment member 284 is press fit in the holes 264 of the stepchain links 230b and in the needle bearings in the holes 266 of the stepchain links 230b. The needle bearings rotate around the attachment member 284. A cap 286 and a stepchain roller 288 are
30 attached to the opposing ends of the attachment member 284 after the attachment member 284 is inserted.

As shown in Figures 8C through 10, an outer portion 272 is attached to the inner portions of each link. In this example, each outer portion 272 is made up of two pieces, although more or fewer pieces could be used. The outer portion 272 includes a first side 274 and a second side 276 that are on opposite sides of the corresponding inner portion. A bottom surface 278 includes a plurality of teeth 232 having a profile that cooperates with the outer surface 34 of the drive member 36.

When assembled, as shown in Figures 8D and 10, the plurality of inner teeth 268 of the inner portions are nestingly received into grooves 271 on an inner side of the bottom surface 287. The outer portions 272 provide an engagement surface for the drive member 36 independently without bearing the tensile loads on the link. The inner portions bear the tensile load.

The inventive arrangement allows for a wide stepchain link 130, 230 and drive member 36 interface (shown in Figure 10) without having an undesirably high link weight. Preferably, the interface between the stepchain links 130, 230 and the drive member 36 is 40 mm to 100 mm. Most preferably, the interface is 65 mm. There is also a substantially constant teeth 132 width and pitch across the span between adjacent teeth 132. The inner portions are advantageously heavier gauge steel in one example compared to the outer portions. The inner portions are strong enough to bear the tensile loads while the outer portions 272 provide more surface area for better engagement with the drive member 36. But the outer portions 272 need not carry the tensile loads.

Returning to Figures 8C and 8D, the sides 274 and 276 of each outer portion 272 include a plurality of attachment holes 290 that align with the attachment holes 270 of the corresponding inner portions. An attachment member 282 is inserted into the aligned holes 270 and 290 to secure the outer portion 272 to the inner portions. When assembled, the outer portion 272 of one stepchain link 230 does not contact the outer portion 272 of an adjacent stepchain link 230. As shown in Figure 8E, the attachment members 282 are inserted in the aligned attachment holes 270 and 290 and rotated up to 45° to create an interference fit.

Figure 11 illustrates one of the attachment holes 290. In the illustrated example, each attachment hole 270 and 290 is generally square shaped and at least a

portion of the attachment members 282 have a corresponding cross-section. In the illustrated example, the attachment members 282 are inserted in the aligned attachment holes 270 and 290 and rotated up to 45° to create an interference fit. It is to be understood that other shapes of the attachment holes 270 and 290 and attachment members 282 are possible.

Returning to Figure 8D, an attachment member 282 having an axle 252 is inserted into the aligned holes 270 and 290 closest to the stepchain rollers 288. In one example, the aligned holes 270 and 290 also have a generally square cross-section and the attachment member 282 having the axle 252 has a corresponding cross section. The axle 252 is inserted into the aligned attachment holes 270 and 290 and rotated up to 45° to create an interference fit, securing the axle 252 to the stepchain links 230.

Figure 12A illustrates a top view of an attachment member 282. Figure 10 shows the attachment member 282 inserted into the aligned holes 270 and 290 of a stepchain link 230. Each attachment member 282 includes a plurality of flanges 292 that are spaced to receive the link portions between them. In one example, the flanges 292 extend continually around the outer surface of the attachment member 282. The flanges 292 are positioned on opposite sides of grooves 293 between the flanges 292.

Figures 12B illustrates a cross-sectional end view of the attachment member 282 of Figure 12A. As shown, the corners of the grooves 293 are more rounded than the corners of the flanges 292. The attachment members 282 preferably are inserted such that the grooves 293a align with the holes 290 of the outer portion 272, the grooves 293b align with the holes 270 of the outwardly inner portions 262 of the stepchain links 230a, and the grooves 293c align with the holes 270 of the inwardly inner portions 262 of the stepchain links 230b.

When all the parts are properly aligned, the attachment member 282 can be rotated about its axis. The holes 270 and 290 and the outside geometry of the grooves 293 preferably cooperate to provide an interference fit when the attachment member 282 is rotated. The flanges 292 are configured to fit through the holes 270 and 290 during insertion and then to abut corresponding surfaces of the link portions once rotated. The flanges 292 engage the inner portions 262 and the sides 274 and 276 of

the outer portion 272 and maintain the desired lateral spacing between the link portions.

As seen in Figure 8D, a bridge support 280 attached to an inner portion provides a support for the bridge 49 during operation of the conveyor system 20 similar to the bridge support 180 of Figure 4. The bridge support 280 is preferably attached to an inner portion by welding, pins, or the like.

Another example link configuration is shown in Figure 13. An injection molded plate 295 having teeth 294 is snapped on the inner portions 262 and secured by an attachment member 296. The attachment member 296 can be a screw, pin, or another known fastener. The plate 295 provides a non-metallic drive member engagement surface on the links. By employing the plate 295 of injection molded teeth 294, corrosion is reduced.

Although multiple inner portions are used with each link in the illustrated example, one inner portion may be used. Similarly, more than two inner portions may be provided for each link.

The stepchain links 130 and 230 of the present invention carry the loads of the steps 24 and transfer the load from the drive member 36 to the plurality of stepchain links 130 and 230 through the plurality of teeth 132 and 232. Therefore, the stepchain links 130 and 230 carry the load of the passenger conveyor system 20.

The outer portions may take a variety of forms, depending on the selected method of securing the inner and outer portions together. Those skilled in the art who have the benefit of this description will be able to select the best component design to meet their particular needs.

There are several benefits to the stepchain links of the present invention. The teeth 32 are made of a single integrated piece of material. As the width of the stepchain links is greater than the prior art, there is greater surface area contact and better interaction between the stepchain links and the drive member. The polyurethane belt and the bearings reduce the need for lubrication. The stepchain links of the present invention prevent twisting under the eccentric load and prevent buckling while under compression. Additionally, the diecast stepchain links are light in weight and low in cost. As the die cast part is formed of one piece, there is no

CLAIMS

We claim:

1. A drive assembly for a passenger conveyor system comprising:
a drive member; and
5 a plurality of stepchain links each having a plurality of teeth made of an integrated piece of material that engages a corresponding surface on said drive member, said plurality of teeth span an entire width of an interface between said stepchain links and said drive member.
- 10 2. The drive assembly as recited in claim 1 wherein each said stepchain link includes an end having two spaced apart portions that at least partially receive another end of another one of said stepchain links.
3. The drive assembly as recited in claim 2 wherein said two spaced apart
15 portions of said end each include a hole and said another end includes a corresponding hole, and an attachment member is received through said holes and said corresponding hole to secure said end to said another end.
4. The drive assembly as recited in claim 2 wherein said two spaced apart
20 portions comprise at least some of said plurality of teeth.
5. The drive assembly as recited in claim 1 wherein said plurality of teeth are made of metal.
- 25 6. The drive assembly as recited in claim 1 wherein said plurality of said stepchain links form a chain that contacts said drive member at said interface, and said entire width of said interface is transverse to a length of said chain, and said plurality of teeth continually engage said drive member at said interface.

7. The drive assembly as recited in claim 6 wherein said width of said interface between said drive member and said plurality of stepchain links is between 40 mm and 100 mm.
- 5 8. The drive assembly as recited in claim 7 wherein said width of said interface between said drive member and said plurality of stepchain links is 65 mm.
9. The drive assembly as recited in claim 1 wherein said plurality of stepchain links form a chain having a length, and said plurality of teeth have a teeth width which
10 is transverse to said length of said chain, and said teeth width is substantially constant along the entire length of said chain.
10. The drive assembly as recited in claim 1 wherein said plurality of stepchain links form a chain having a length, and said plurality of teeth have a teeth pitch which
15 is substantially constant along the entire length of said chain.
11. The drive assembly as recited in claim 1 wherein each said stepchain link comprises a single piece of die cast metal.
- 20 12. The drive assembly as recited in claim 11 wherein said die cast metal is selected from the group consisting of aluminum and magnesium.
13. The drive assembly as recited in claim 1 wherein each said stepchain link comprises an inner portion comprising at least one planar metal piece and an outer
25 portion having said plurality of teeth.
14. The drive assembly as recited in claim 13 wherein said inner portion includes an opening and said outer portion includes a corresponding opening, and an attachment member is received through said opening and said corresponding opening
30 to secure said inner portion to said outer portion.

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15. The drive assembly as recited in claim 13 wherein each said inner portion is adapted to carry a tensile load on said stepchain links and each said outer portion does not carry said tensile loads.

5 16. The drive assembly as recited in claim 13 wherein said outer portion has a first side and a second side and a bottom portion extending therebetween, said bottom portion having at least some of said plurality of teeth.

10 17. The drive assembly as recited in claim 16 including a second planar metal piece, and wherein a distance between said planar metal piece and said second planar metal piece is less than a width of said bottom portion.

18. The drive assembly as recited in claim 13 including a plate having a plurality of plastic teeth secured on said outer portion.

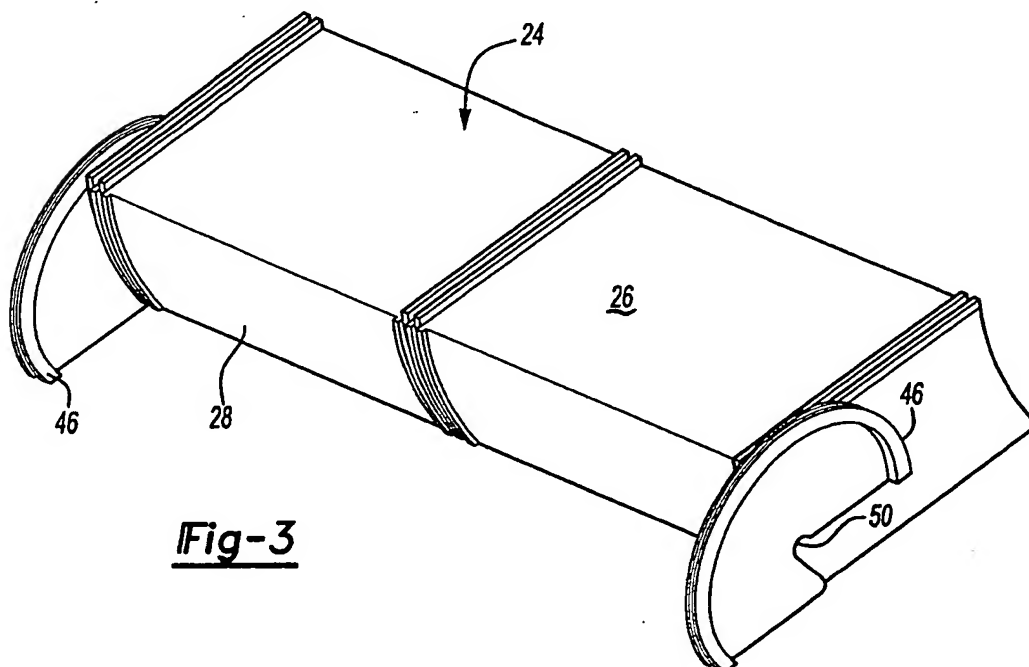
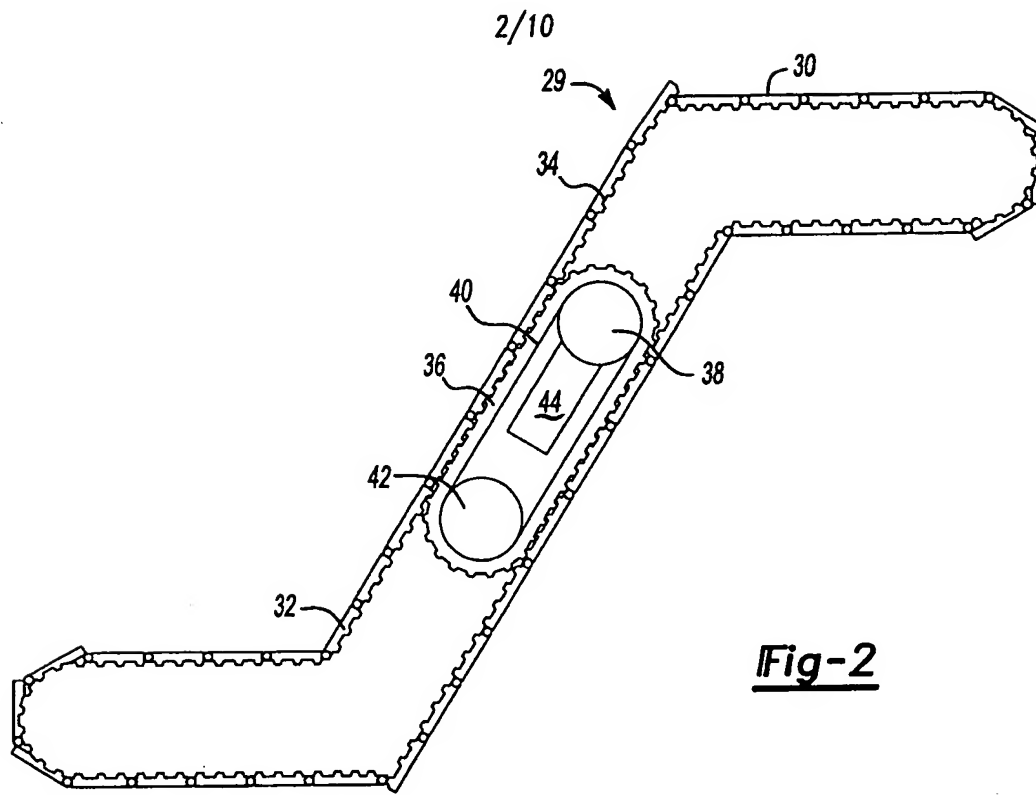
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19. The drive assembly as recited in claim 13 wherein said outer portions of said stepchain links do not contact said outer portion of an adjacent one of said stepchain links.

20 20. The drive assembly as recited in claim 1 wherein each said stepchain link comprises a central body portion including a drive surface having a first link edge and an opposing second link edge, and at least some of said plurality of teeth continuously extend between said first link edge and said opposing second link edge of said central body portion.

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21. The drive assembly as recited in claim 1 wherein said stepchain link comprises a central body portion, and at least some of said plurality of teeth are located on said central body portion.



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Fig-8E

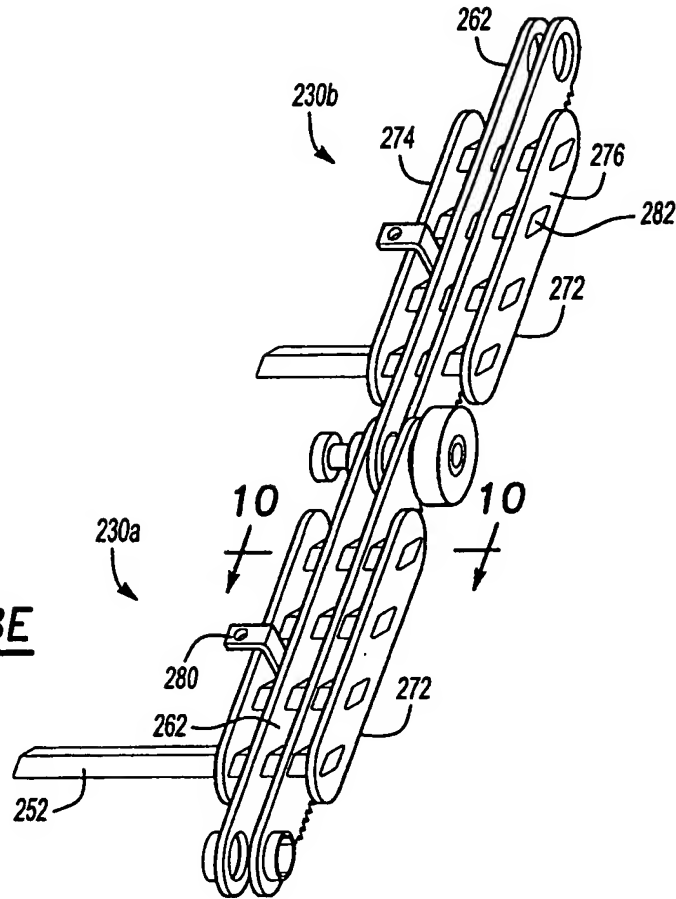
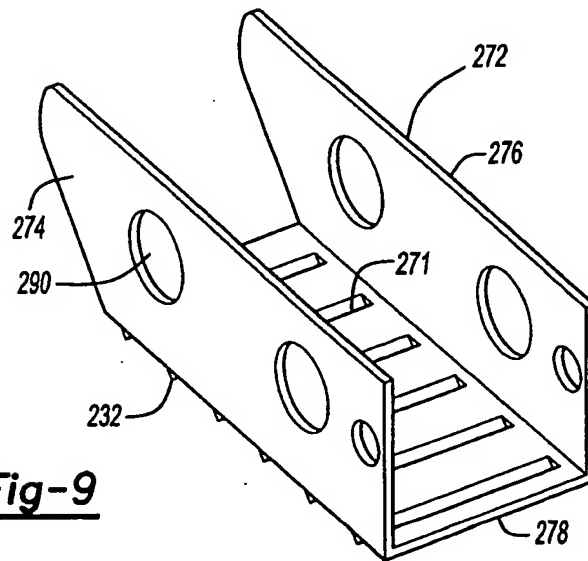


Fig-9



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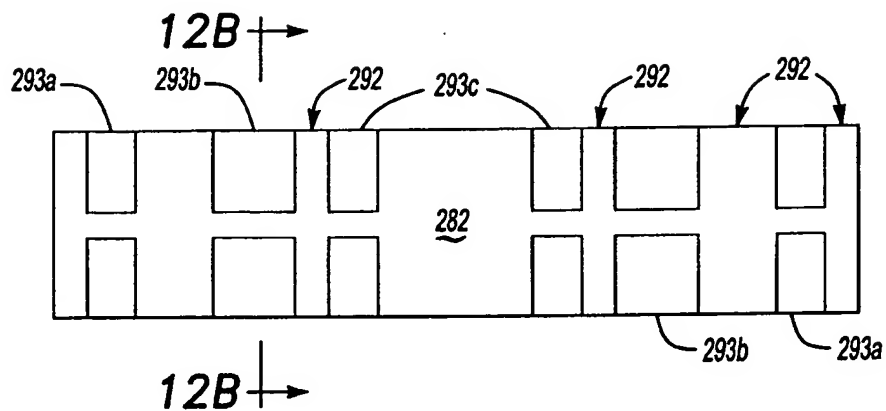


Fig-12A

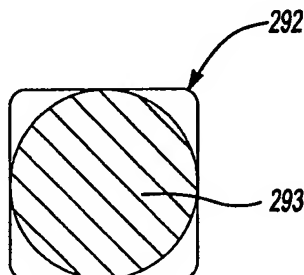


Fig-12B

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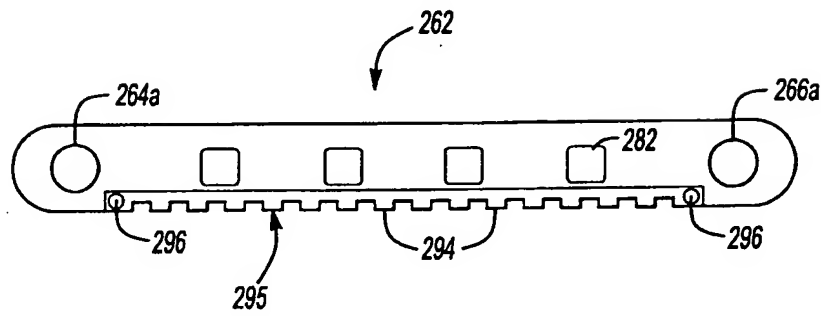


Fig-13

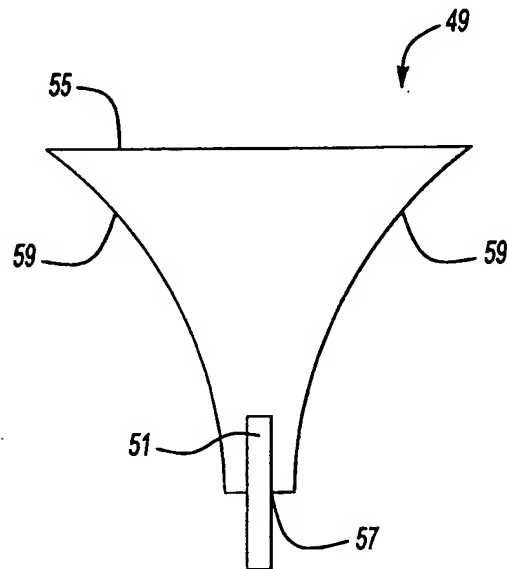


Fig-14